Weapons Phenomena

Atmospheric Detection

Los Alamos NATIONAL LABORATORY EST. 1943

Earth & Environmental Sciences

The development of space-based sensors to detect atmospheric nuclear explosions is important for national security and test-ban treaty verification. In the absence of nuclear testing, we must rely on a theoretical understanding of the entire problem from source to signal. LANL is focused on developing first-principles models and computational tools to help solve this difficult problem.

Left: *Understanding the physics of lightning (inset) is one component in modeling above-ground nuclear blasts. (Pictured: first hydrogen bomb blast, 1952).*

Background

The nature of the primary emissions from the source, the propagation of those emissions to the detector, the detailed nature of the natural and anthropogenic background in which these satellites operate, and finally the characteristics of the detector must all be understood in minute detail. We develop systems codes that can be used to support performance assessment and optimization of sensors. Lightning is a major source of optical, radio frequency and X-ray impulses, and one of the goals of our program is to understand the fundamental nature of thunderstorm electrical discharges in order to develop lightning models that predict the associated electromagnetic emissions that are observed from space.

Capabilities

We employ a multi-pronged approach towards estimating electromagnetic pulse and optical signals. First, we run legacy codes which we have benchmarked against existing data. Second, we work to expand and enhance the capability and performance of existing codes. Finally, we develop new codes often starting from first-principles. The ability to include detailed radiation transport, self-consistent electromagnetic solvers, atmospheric chemistry, multi-fluid and/or mult-phase capability can all be important to properly address various scenarios of interest.

Future Applications

Understanding the first-principles science behind the detected signals also leads to the ability to help design future satellites that could be configured more optimally or configured to take advantage of different mission opportunities.

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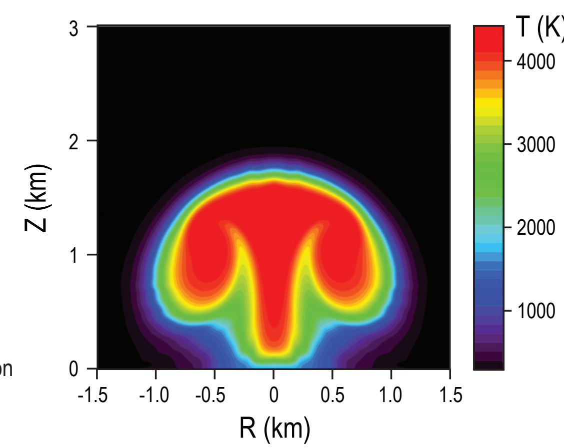

Right: Simulated temperature distribution from a 1 megaton burst 500 m above ground at 2.764 seconds.

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